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PASSIVE AIRCRAFT STATUS SYSTEM (PASS)

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Final Report for the Period August 1999 to August 2001

Human Effectiveness Directorate
Deployment and Sustainment Division
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FOR THE COMMANDER

ALBERT S. TORIGIAN, Lt Col, USAF
Deputy Chief
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The Passive Aircraft Status System (PASS) concept addresses the timing and accuracy of aircraft information (system failures, consumables, aircraft status, etc.) available to maintenance personnel and to alleviate maintenance issues by providing accurate and detailed information to the maintenance environment before the aircraft landing. The maintenance community uses this information to plan and schedule the aircraft's next activity (fly or fix). The effort occurred in three phases: 1) Technology Review and Data Collection - to investigate and review the communications, information displays, and state-of-the-art technologies currently available for possible use in a PASS, 2) Design and Analysis - to define the functions required to fulfill the concept, identify potential different approaches for a PASS implementation, and prioritize the recommended approaches to develop the concept for a field demonstration, 3) Preliminary Plan for Technology Development - to encapsulate and demonstrate the benefits of PASS in current and future maintenance process.

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PREFACE

This report, prepared by staff members of NCI Information Systems, Inc., 3150 Presidential Drive, Fairborn, OH, 45324, is the Final Report, CDRL A020, for the Passive Aircraft Status System (PASS) under contract F41264-99-F-0007. All work under the contract was performed for the Air Force Research Laboratory, Human Effectiveness Directorate, Logistics Readiness Branch, Wright-Patterson AFB, OH, under the direction of the Program Manager, Paul Faas.

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1. INTRODUCTION

The Passive Aircraft Status System (PASS) concept addresses the timing and accuracy of aircraft information (system failures, consumables, aircraft status, etc.) available to maintenance personnel and to alleviate maintenance issues by providing accurate and detailed information to the maintenance environment before the aircraft landing. The maintenance community uses this information to plan and schedule the aircraft's next activity (fly or fix). The effort occurred in three phases (Technology Review and Data Collection, Design and Analysis, and Preliminary Plan for Technology Development) with each phase having different purposes.

a. Phase One – Technology Review and Data Collection. The purpose of the data collection phase was to investigate and review the communications, information displays, and state-of-the-art technologies currently available for possible use in a PASS. PASS could enhance the current means of relaying aircraft and payload information to key ground maintenance resources that affect subsequent sortie generation. Phase 1 determined the technical feasibility of PASS downlink data and the feasibility of putting the PASS system on the aircraft.

b. Phase Two – Design and Analysis. The purpose of the design and analysis phase was to define the functions required to fulfill the PASS concept, identify potential different approaches for a PASS implementation, and prioritize the recommended approaches to develop the concept for a field demonstration. Phase 2 documented the data collection efforts and determined benefits of PASS for the current maintenance processes.

c. Phase Three - Preliminary Plan for Technology Development. The purpose of the Preliminary Plan for Technology Development phase was to encapsulate and demonstrate the benefits of PASS in current and future maintenance processes. Phase 3 provided insight and documentation of the initial software development required and accomplished for the PASS program.

2. BACKGROUND

In aircraft legacy systems, significant amounts of sensor data are available for capture on-board. The aircraft data capture in some legacy aircraft is consolidated into a data transfer cartridge or module that is eventually downloaded at the operations-to-maintenance debrief. In most cases, the only airborne relay of critical aircraft information is pilot initiated in a voice squawk. Within the current general concept of operations, there is no electronic air-to-ground linkage of aircraft status data. The PASS concept attempts to break this barrier by sending the maintenance data down early to benefit the maintenance personnel and serve as a force multiplier for generating subsequent sorties.

3. PASS CONCEPT

The fundamental and most critical maintenance requirement that the PASS concept fulfills is notifying key flightline maintenance supervisors of aircraft status and any detailed failure information before landing. This in-depth condition of the aircraft can be used to start the maintenance and debrief cycles simultaneously. While the aircraft is still airborne, the converted data is then accessible to all maintainers, via Radio Frequency (RF) or Local Area Network (LAN) connection allowing access to real-time status and fault data. Having this information before the aircraft lands allows maintainers to make informed maintenance decisions before the aircraft lands. The goal of the PASS concept is to provide accurate and detailed information to maintenance personnel in a consistent and timely manner before the aircraft lands. There is currently no such capability in today's legacy aircraft.

The PASS concept addresses the need for detailed information such as aircraft system and subsystem failures, fuels and munitions expenditures, etc., to be available to maintenance personnel while an aircraft is airborne so that preparations for maintenance turnarounds and other planning can be achieved to expedite the return of the aircraft to mission ready status. Additionally, the PASS concept attempts to alleviate maintenance issues such as determining the complete health status of the aircraft and all its major systems/subsystems needed for the next sortie. The key to the PASS concept is for aircraft data (from the aircraft systems) to be collected, transferred to the ground via RF connection, and converted into a textual format (e.g., fault codes) useable by maintenance personnel before landing.

The converted data is then accessible via a RF or LAN connection to key maintenance supervisors before the aircraft lands, allowing access to real-time status and fault data. The PASS concept requires seamless integration with existing software tools, such as Core Automated Maintenance System (CAMS) or Core Automated Maintenance System For Airlift (G081), or forthcoming concepts under development, such as the System Program Office's (SPO's) versions of Integrated Maintenance Information System (IMIS).

One benefit of the PASS concept is making detailed information such as aircraft system and subsystem failures, fuels, munitions expenditures, etc., available to maintenance personnel while an aircraft is still airborne. Another benefit is the potential to accomplish critical maintenance issues, such as determining the complete health status of the aircraft and all its major systems/subsystems needed for the next sortie.

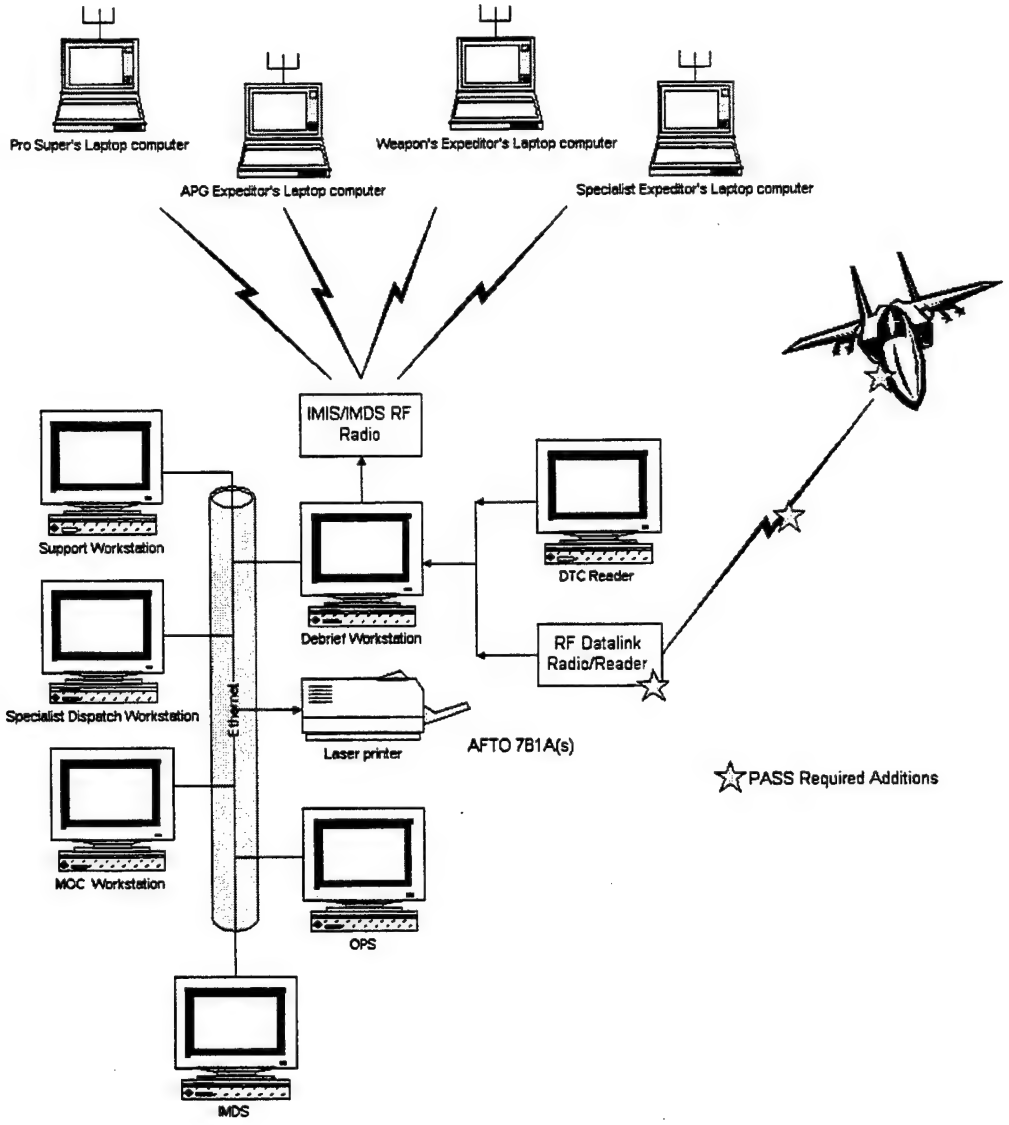

Figure 1 – Passive Aircraft Status System Concept

The following paragraphs describe today's operational method and provide a concept of future "to-be" methods with PASS as a performance enhancement for improving legacy systems and new weapon systems platforms in the out years.

3.1 Today (AS-IS)

In today's environment, pilots typically radio a code squawk when returning from a mission. This code squawk is a high-level status report providing the general condition of the aircraft, as assessed by the pilot during the mission. To meet the requirements of the remaining flying schedule or other flightline maintenance activities, a maintenance supervisor uses this code squawk, along with other information, to determine the type of maintenance to be performed on the aircraft. Other information used in determining the maintenance needed to turn the aircraft for its next sortie includes evaluating the

anticipated required turn time against available flightline resources (people, equipment, tools, etc.), aircraft, or system faults. In today's environment, a code squawk is generally inconsistent with the final aircraft status condition after debrief is completed. Additionally, the timing of this squawk is inconsistent and may occur anywhere from entry into the landing pattern to just before engine shutdown. These aircraft squawks are the aircrew's determination of the aircraft condition and are in the form of status codes.

Table 1 – Status Codes are used to notify the maintenance community if the aircraft is capable of being used for the next mission without maintenance (other than the normal turn requirements).

Table 1 – Status Codes

Code	Status
Code 0	Ground Abort
Code 1	Aircraft Mission Capable With No Additional Discrepancies
Code 2	Aircraft Or System Has Minor Discrepancies But Is Capable Of Further Mission Assignment Within Normal Turnaround Times
Code 3	Aircraft Or System Has Major Discrepancies In Mission Essential Equipment That May Require Extensive Repair Or Replacement Prior To Further Mission Assignment
Code 4	Aircraft Or System Has Suspected Or Known Radiological, Chemical, Or Biological Contamination
Code 5	Aircraft Or System Has Suspected Or Known Battle Damage

Current aircraft collect and store aircraft status information, but human intervention is required to transfer that data to maintenance personnel before landing or during taxi before engine shutdown. On aircraft such as the F-15 and F-16, this information is collected and transferred to debrief personnel via the maintenance data transfer cartridge (DTC). On other aircraft, the failure information is made available in debrief by the aircrew. The task of translating this information into a usable format is the debriefer's responsibility. The debriefer may use a DTC reader or computerized debrief system such as Computerized Fault Reporting System (CFRS) or Computerized Fault Isolation (CFI). During debrief, it may be necessary to look in the Fault Reporting Technical Orders (TOs). The debriefer ensures the aircraft forms (Air Force Technical Order [AFTO] Form 781A) reflect accurately the aircraft discrepancies and that the information is updated in the maintenance data system in use (CAMS, IMIS, G081, etc.) to show each discrepancy. A job must be entered in the maintenance data system before any parts or work can be performed on that discrepancy. Flight durations are also entered at this time, which aid in upkeep of accurate aircraft information for timely completion of scheduled maintenance and other activities.

Today's maintenance flow, as shown in Figure 2, runs sequentially from aircraft land until crew ready for next mission. Some of the activities can run concurrently based on the squawk, however they are at risk based on the accuracy of the squawk information.

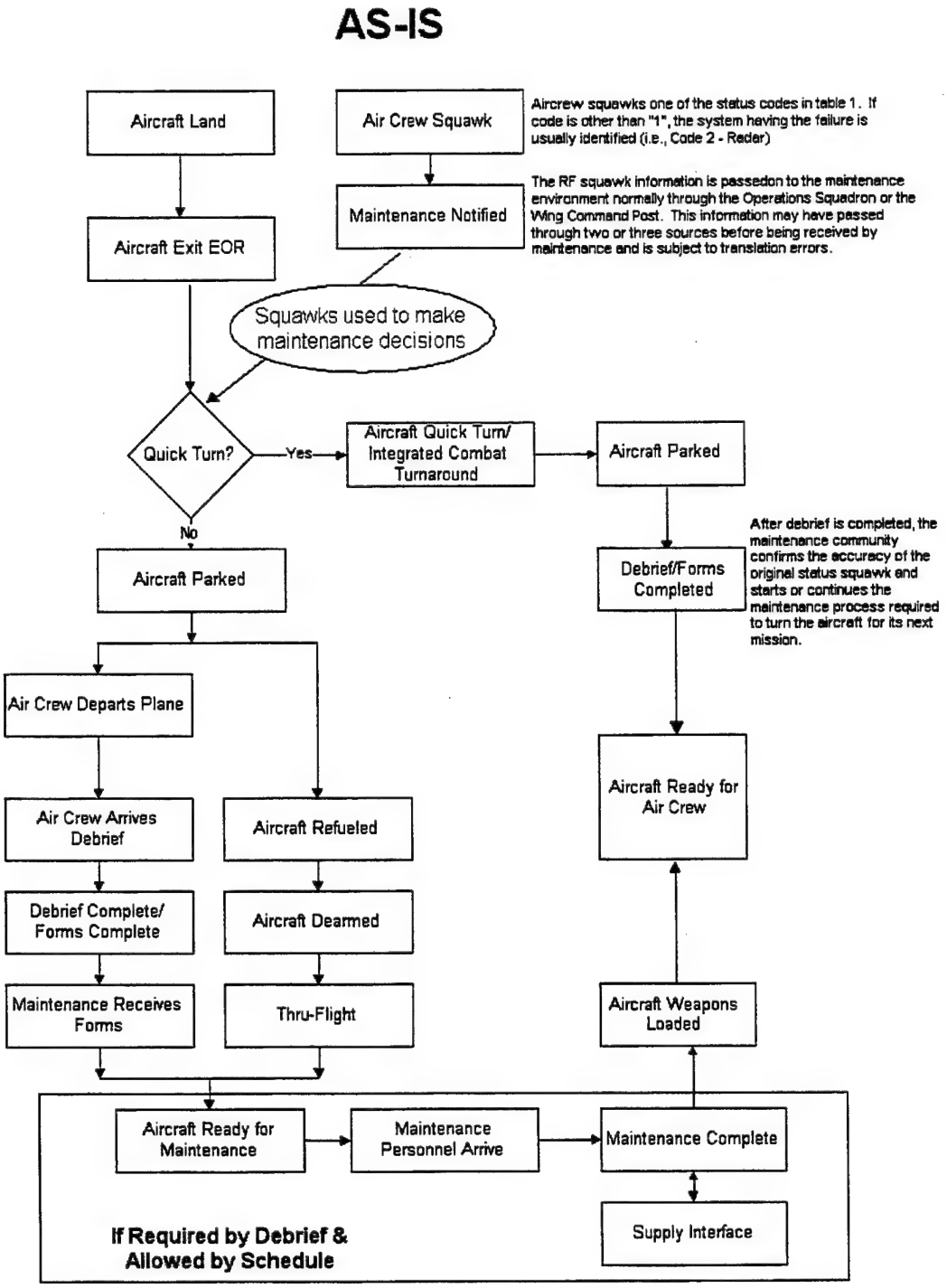

Figure 2 – AS-IS Aircraft Maintenance Flow

3.2 Tomorrow (TO-BE)

Implementation of the PASS concept puts correct and detailed data in the hands of the appropriate maintenance personnel before the aircraft returns from the mission. This leads to better maintenance decisions in areas such as manning, planning, part

cannibalization, and determination and acquisition of necessary parts. One of the underlying benefits of the PASS concept is quicker aircraft turn times and Mission Capable (MC) rates for status code 2 through 5 aircraft. Figure 3 – TO-BE Aircraft Data Flow shows how the maintenance processes could flow using the PASS concept. This concept allows concurrent maintenance efforts with reduced risk because it is based upon current, accurate information from the aircraft.

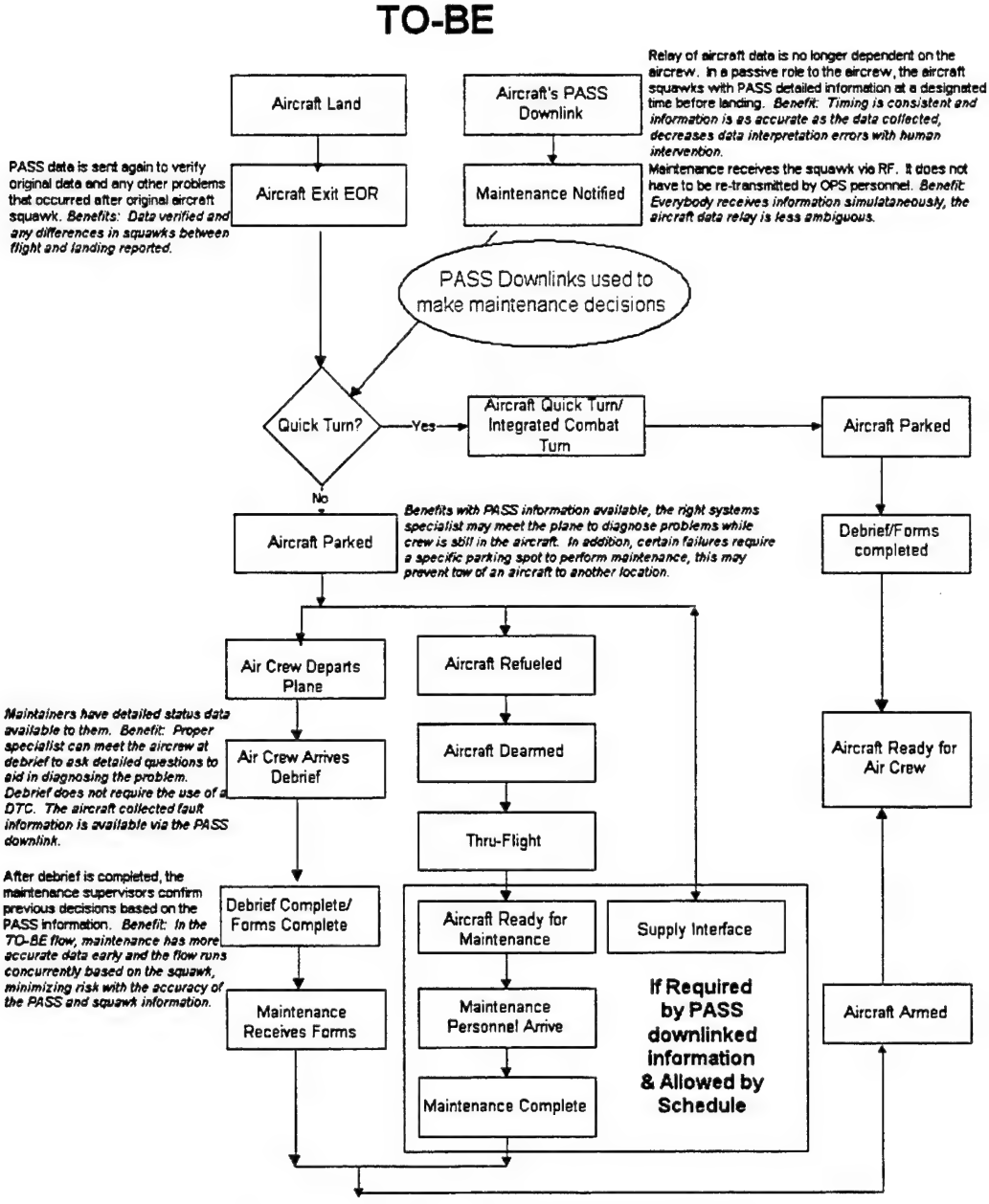

Figure 3 – TO-BE Aircraft Data Flow

4. FINAL PASS DEMONSTRATION SCREENS

To demonstrate the PASS concept, Phase Three - Passive Aircraft Status System (PASS) Preliminary Plan for Technology Development, identified requirements and

provided a proposed design for a PASS demonstration system. Due to the nature of the demonstration, the screens were conceptual. This section identifies the screens developed to provide required information to the maintainer and gives a detailed explanation of their features and how to run the PASS Demonstration.

4.1 Simulation

A simulation of PASS was developed that provides a tool to run pre-defined scenarios imitating squawks from the aircraft to the ground via RF to demonstrate the PASS concept on the client screens. In the demonstration, the simulation sends RF squawks to the WebServer/User laptop via a RF modem. The simulation screen is a continuous real-time display of the events occurring in the scenario at the times specified in the scenario. The developed simulation of PASS is described in the following paragraphs. The simulation is located on the simulation laptop.

4.1.1 Starting the Simulation

Selecting the Sim Desktop Icon (Figure 4) starts the simulation. Upon selection, the initial Simulation Screen is displayed as shown in Figure 5. Table 2 – Simulation Tool Main Selection Definitions, provides a brief overview of the main selections of the simulation tool.

Figure 4 – Sim Desktop Icon

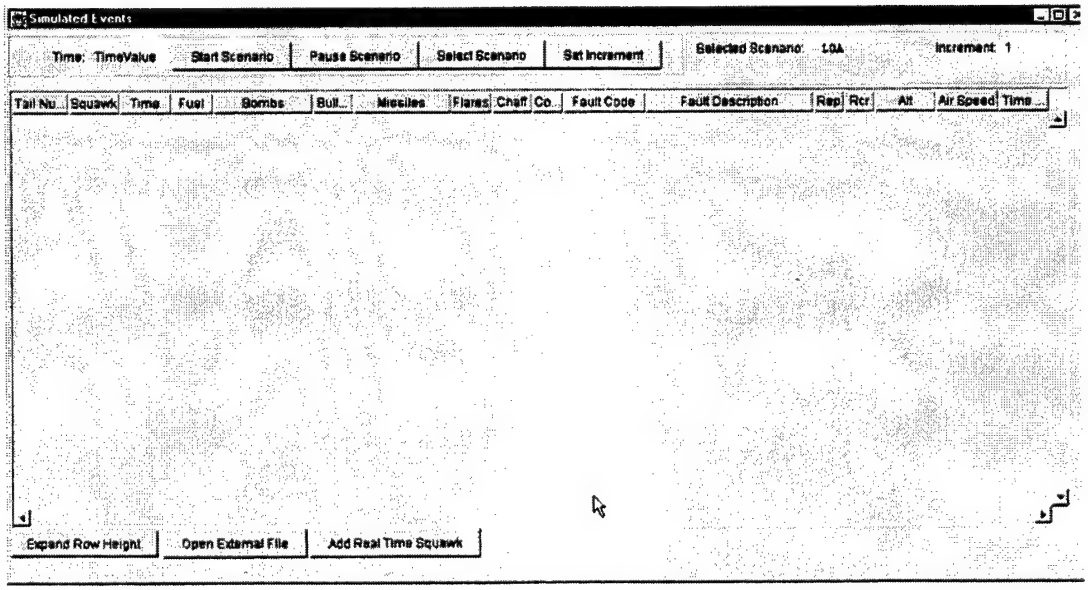

Figure 5 – Initial Simulation Screen

Table 2 – Simulation Tool Main Selection Definitions

Selection	Description
Time	Indicates the time of squawk from the beginning of the scenario.
Start Scenario	Allows the user to start the scenario indicated in the Selected Scenarios section.
Pause Scenario	Allows the user to pause the scenario during real-time mode.
Select Scenario	Allows the user to select a scenario to run, see Figure 6 – Select Scenario Menu.
Set Increment	Allows the user to compress time, see Figure 8 – Set Increment Menu.
Selected Scenarios	Indicates the currently selected scenario. This is a read only field and is updated when the user selects a different scenario from the Select Scenario menu; see Figure 6 – Select Scenario Menu.
Increment	Indicates the current interval the scenario is running at, see Figure 8 – Set Increment Menu.
Squawk Data	Includes Tail Number, Squawk etc. These will be discussed in detail in Figure 7 – Example of Running Scenario.
Expand Row Height	The Bombs and Missiles fields are multiple row fields. This feature allows the user to expand or decrease the row height in order to see the all information within these fields. See Figure 9 – Example of Expanded Row Height Simulation Screen.
Open External File	Allows the user to open an external text, MS Word or MS Excel document into its native window. See Figure 10 – Open File Menu.
Add Real Time Squawk	Allows the user to enter a Pilot squawk in real-time while a scenario is running. See Figure 11 – Real-Time Squawk Menu.

To start the simulation the user enters the Select Scenario button and the Select Scenario menu is displayed, see Figure 6 – Select Scenario Menu. The menu allows the user to select which scenario is to be used when the Start Scenario button is selected. If the user selects a scenario, the Selected Scenarios read only area is updated to reflect the selected scenario.

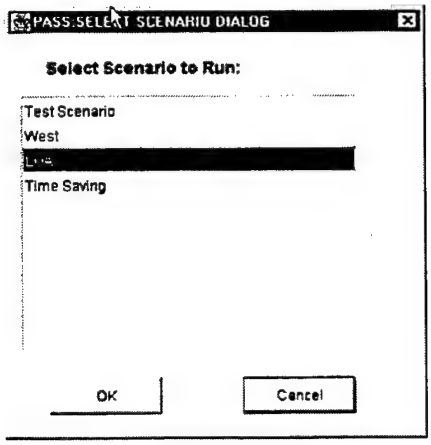

Figure 6 – Select Scenario Menu

The user then selects the Start Scenario button after he has started the WebServer (refer to paragraph 4.2). Once started, squawks defined in the scenario are processed and displayed on the Simulation Menu (see Figure 7 – Example of Running Scenario). The scenario will run until completion.

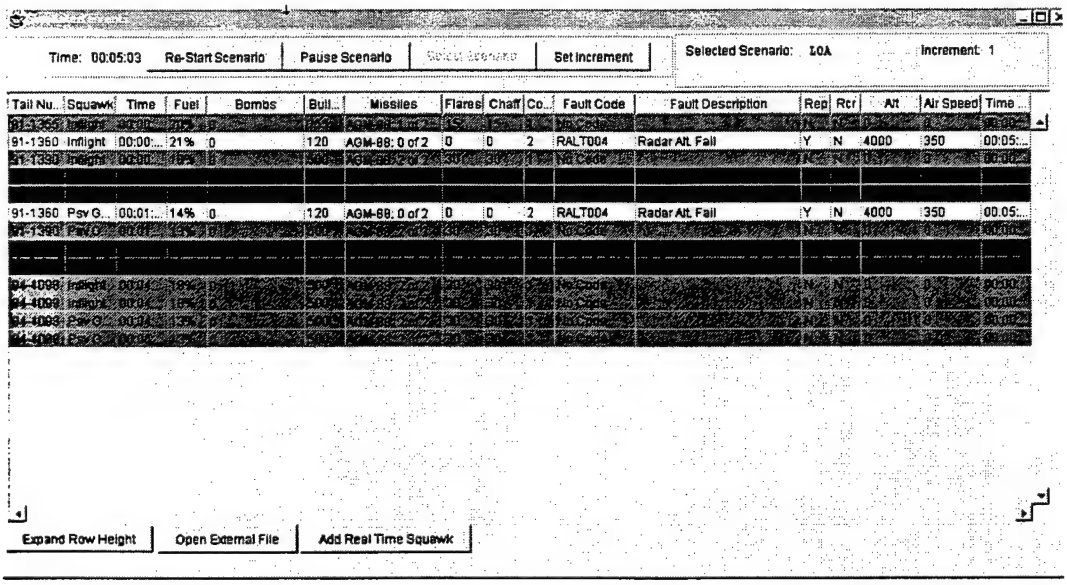

Figure 7 – Example of Running Scenario

The squawk information (as shown in Figure 7) is read only and is defined as follows:

a. TailNumber – identifies the tail number the data is detailed for.

b. Squawk

1. Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing.

2. Pilot – Normal UHF pilot squawk (Code 1,2, or 3 with a subsystem).

3. Passive Ground – Verification of collected fault data transmitted via RF link at End Of Runway (EOR).

4. Active Ground – Human activated squawk transmitting fault codes via RF link while on the ground. (Used for Ground Abort, Redballs).

5. Debrief – Detailed fault data and write-ups from debrief processing.

c. Time of squawk – Time the squawk occurred.

d. Fuel – Percentage of fuel remaining are displayed in percentage remaining.

e. Bombs– Number of bombs expended based on configuration of aircraft (e.g., 1 of 2).

f. Bullets– Number of bullets expended.

g. Missiles – Number of missiles expended based on configuration of aircraft (e.g., 2 of 2 AIM-120).

h. Flares - Number of flares expended.

i. Chaff - Number of chaff expended.

j. Code – Minimum Essential Systems List (MESL) Code pertaining to this fault code.

k. Fault Code – Alphanumeric code indicating the failure.

l. Fault Description – Word description of the fault.

m. Repeats –Yes, if fault occurred in last flight. No, otherwise.

n. Recur - Yes, if same fault occurred within last five flights. No, otherwise.

o. Air Speed – Speed of aircraft when fault occurred.

p. Altitude – Altitude of aircraft when fault occurred.

q. Time – Time when fault occurred.

Note: Upon completion of the scenario the Start Scenario button changes to a Re-Start Scenario button. The user may select this button to clear the current scenario and restart the scenario without having to restart the entire simulation process.

4.1.2 Other Simulation Features

The user is able to compress time by using the Set Increment menu, see Figure 8. By default "1" is the entered number, however if a higher number is entered, the scenario time will increase by the increment selected for every real second that is passed (e.g., If 10 is selected as the current increment, then for every one second of real time, ten seconds of scenario data will occur).

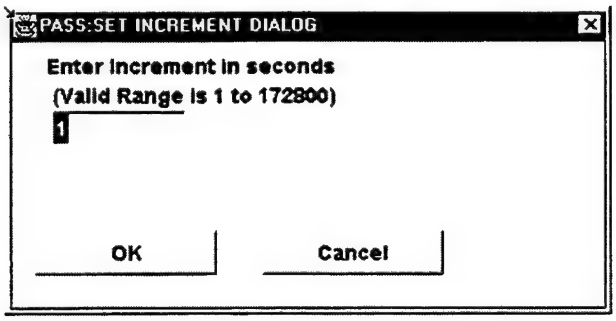

Figure 8 – Set Increment Menu

The user is able to expand the row height to view the full bombs and missiles data by selecting the Expand Row Height button. Figure 9 shows an example of the scenario data with the rows expanded. To return the simulation to its original row height, the same button, now labeled Decrease Row Height, may be selected, and the row height is returned to its original state.

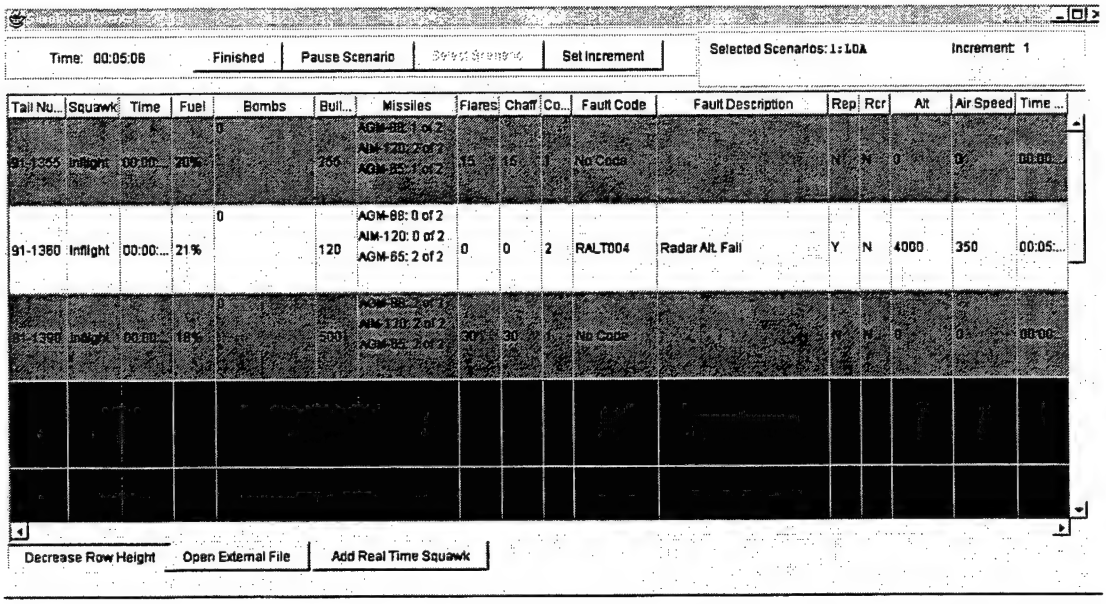

Figure 9 – Example of Expanded Row Height Simulation Screen

The user is able to check flight schedules or access data from other files or databases. Figure 10 – Open File Menu shows the interface that opens upon selection of the "Open External File" button. The simulation opens to a default directory where PASS related files are stored. Selecting a file and clicking the Open button will cause the specified file to open in its native application.

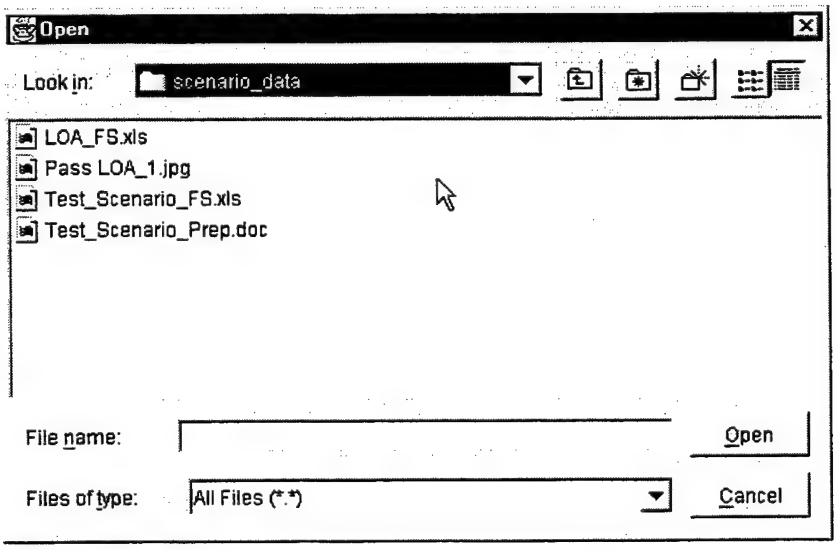

Figure 10 – Open File Menu

The user is able to add a real time pilot squawk into the current scenario when the scenario is in a paused state. Upon selecting the Real Time Squawk button, a Real Time Squawk menu appears, see Figure 11 – Real-Time Squawk Menu, allowing the operator to enter a tail number, an aircraft status code (in the pilot code squawk field), and comments. If Enter New Squawk button is selected, the real time squawk is sent to the WebServer in the same manner as a squawk read from the scenario database. However, this squawk is only sent to the WebServer and is not stored as a permanent addition to the current scenario.

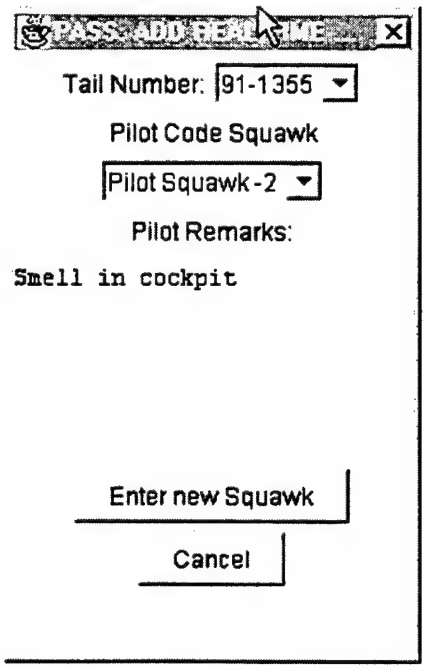

Figure 11 – Real-Time Squawk Menu

The user may run the simulation in real-time or Step-By-Step Mode. This choice is presented to the user upon completion of the scenario sending initializing data to the WebServer, but before any squawk events have occurred. The user is presented with a dialog requesting how the scenario should be run; see Figure 12 – Select Simulation Mode. Real Time mode is when the scenario is played in real time or compressed time based on the current increment setting. Step-By-Step is a separate mode, which allows the user to step through the scenario squawk by squawk at his/her own pace by selecting the Next button, see Figure 13 – Next Button.

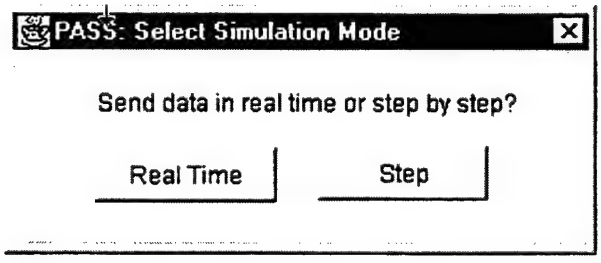

Figure 12 – Select Simulation Mode

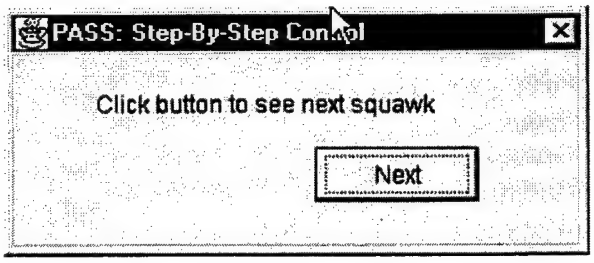

Figure 13 – Next Button

4.2 WebServer

The WebServer acts as the central data processor to receive, decode, store, and distribute PASS information. The WebServer receives data from the simulation via RF, stores the data, and distributes the data to any clients requesting PASS information. The WebServer also receives data from the clients, stores the data, and distributes the data to any clients requesting PASS information. The WebServer is located on the WebServer/User laptop.

4.2.1 Starting the WebServer

The PASS Demonstration is started from the WebServer/User laptop by selecting the shortcut icon located on the desktop as shown in Figure 14 – PASS Desktop Icon. By selecting the PASS icon, the Web Server window (see Figure 15 – Web Server window) is displayed.

Figure 14 – PASS Desktop Icon

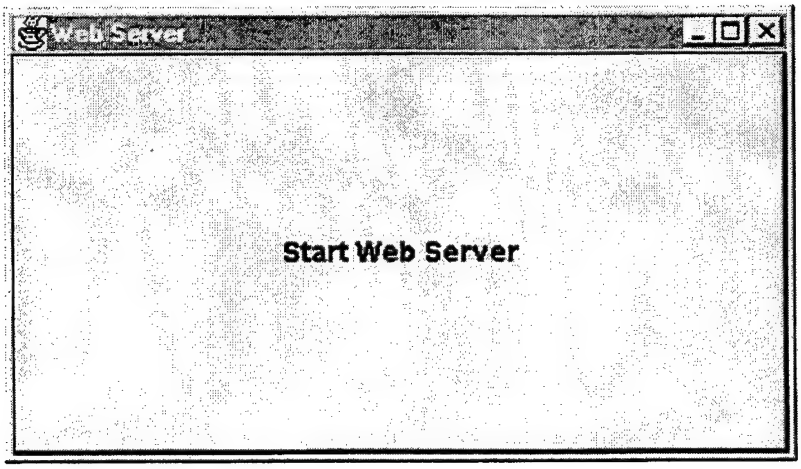

Figure 15 – Web Server window

By selecting the large Start Web Server button, the WebServer is started and is ready to receive data from the simulation and clients. As data is received, the Web Server window is updated to identify the received message, see Figure 16 – Web Server Window Indicating Received Message.

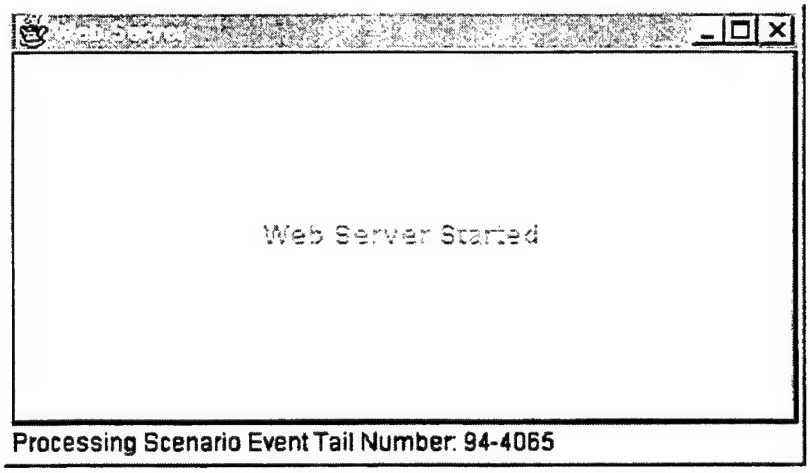

Figure 16 – Web Server Window Indicating Received Message

The Web Server continues processing the entire time the PASS Demonstration is running. It is responsible for receiving data from the simulator and clients, storing the information, and then sending the data to any clients who should receive the data.

4.3 Maintenance Users

The maintenance community has key supervisors managing flightline activities to ensure proper maintenance is performed on the aircraft. The number of supervisors varies from flightline to flightline; however, the general way of doing business remains the same throughout. The PASS Demonstration limits itself to the following management positions:

a. Production Superintendent (Pro Super) – Maintenance person in charge of all aircraft in a squadron. This person makes the status and code decisions for all the aircraft.

b. Airplane General (APG) Expediter – Maintenance person in charge of a flight of aircraft in an aircraft maintenance unit. This person is in charge of getting all maintenance work performed on these aircraft. There are two APG Expediters (APG1 Expediter and APG 2 Expediter) allowed for each squadron of aircraft in the demonstration.

c. Specialist Expediter– Maintenance person in charge of maintenance specialties for all aircraft in the squadron.

The maintenance users may access the PASS maintenance data through the Maintenance User applications. The Client applications are located on the

WebServer/User laptop.

4.3.1 Starting the Client Screen

The client screen login, shown in Figure 17 – PASS Login Screen, is also displayed upon selecting the PASS icon (see Figure 4 – Sim Desktop Icon). The PASS Login screen allows entry into the PASS application upon verification of a User Name and Password. The User Name also identifies the type of user to the PASS application and shows the appropriate PASS user screen.

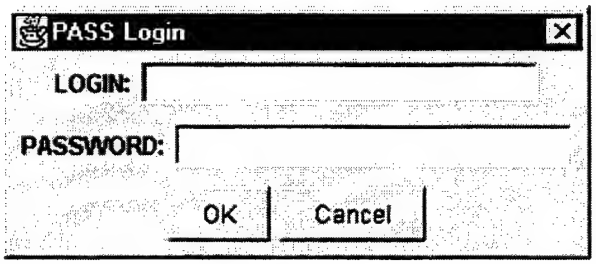

Figure 17 – PASS Login Screen

If a second client screen is desired or the user has canceled out of the login screen, the login screen may be started by selecting the Client Desktop Icon, shown in Figure 18.

Figure 18 – Client Desktop Icon

4.3.2 Pro Super Screens and Privileges

If the user logs in as a Pro Super, a screen similar to Figure 19 – Pro Super PASS Concept Screen is displayed. By selecting the orange help key located near the top of the display, a help file is opened in a browser window with the same type of information provided in this section.

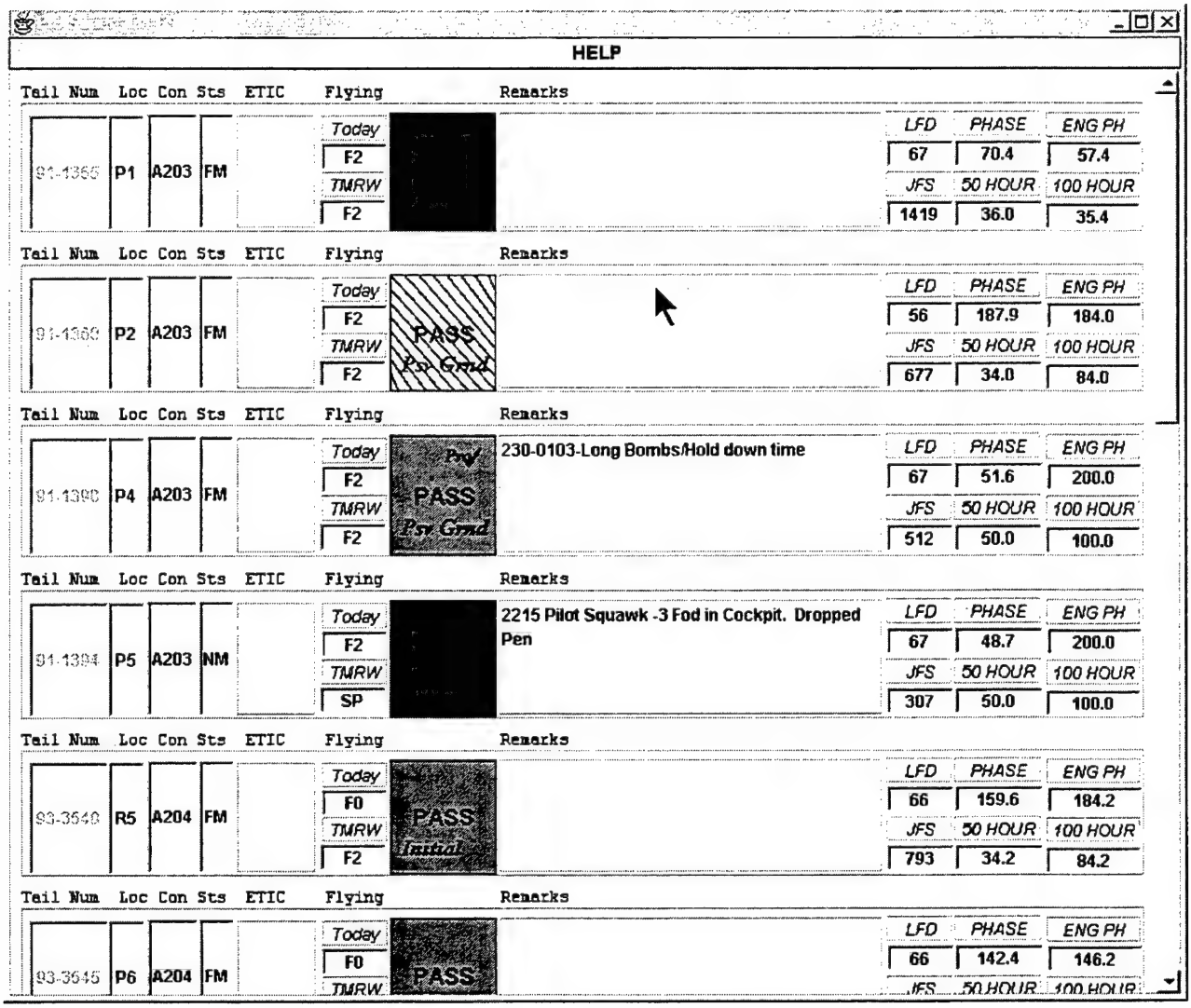

Figure 19 – Pro Super PASS Concept Screen

The screen is an electronic representation of the current clipboard status sheet used in today's maintenance environment. A row for each tail number assigned to the Pro Super is displayed along with any pre-set scenario data for each aircraft. A single tail number and the data it displays are shown in Figure 20 – Pro Super Individual Tail Number.

Figure 20 – Pro Super Individual Tail Number

The tail number data represents the IMIS environment, which would become an

integral part of PASS (see Table 3 – PASS Related Areas).

Table 3 – PASS Related Areas

Area	Description
Tail Number	Indicates the tail number this row contains data for (Read Only).
*Loc	Location of the aircraft / Parking spot.
*Con	Indicates the type of configuration the aircraft is in.
*Status	Indicates the status of the aircraft. FM: Fully mission capable or Code 1. PM: Partially Mission capable or Code 2. NM: Not mission capable/Hard broke or Code 3.
ETIC	Estimated Time In Completion – Available for the Pro Super to make notes for himself on the completion time for the aircraft maintenance. (Note: This area pertains only to this Pro Super, these changes are not sent to any other user).
*Flying Today	How many times the aircraft is scheduled for flight today (e.g., F2 equals two flights for this aircraft today).
*Flying TMRW	How many times the aircraft is scheduled for flight tomorrow (e.g., F2 equals two flights for this aircraft tomorrow).
*PASS Button	Indicates the code of the aircraft based on the visual indicators, see Figure 12 – Select Simulation Mode.
Remarks	Area available for the Pro Super to write notes or issues down pertaining to this aircraft. (Note: This area pertains only to this Pro Super, these changes are not sent to any other user).
*LFD, *PHASE, *ENG *PHASE, *JFS, *50 Hour, *100 Hour	Common aircraft maintenance information to indicate how close to certain major maintenance milestones the aircraft is.

* Any changes made to these fields by the Pro Super are sent to the APG Expediters and Specialist screens in real-time.

The button labeled PASS has been added to the electronic Pro Super status sheet. The Pro Super may select the PASS button to display the PASS DATA window. The PASS DATA window displays data for the indicated tail number, see Figure 21 – Pro Super PASS Data Screen.

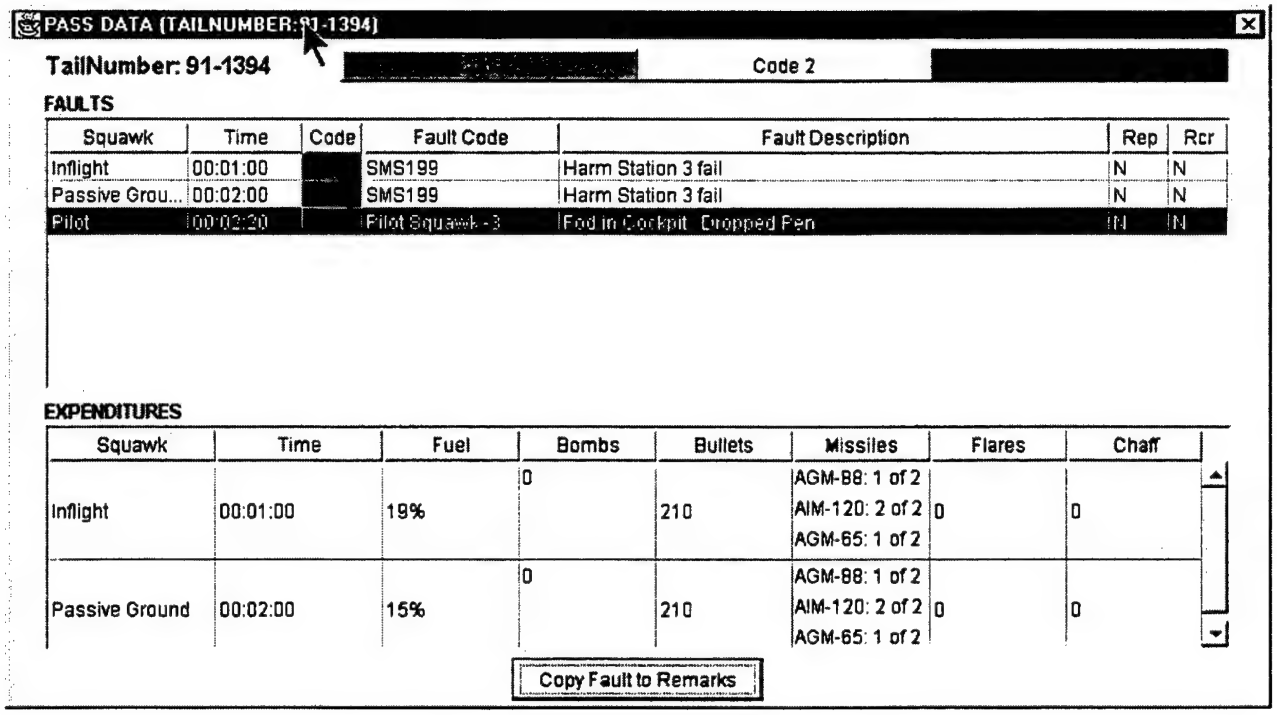

Figure 21 – Pro Super PASS Data Screen

The PASS data available and the privileges (defined in italics) to the Pro Super consist of:

a. TailNumber – identifies the tail number the data is detailed for *(Read Only)*

b. Code 1, 2, and 3 buttons – Allows the Pro Super to select the current code of the aircraft based on the squawk entries and the data available on the status sheet. The code defaults to the lowest code in the code column based on the latest squawk information. The Pro Super may either exit, accepting the default selection, or make a code selection. Upon exit or selection of the code, the status sheet updates the PASS button with the proper color and code and updates all other displays real-time. *(Pro Super selection)*

c. Faults *(Read Only)*: The faults indicate the PASS or Pilot data transmitted.

d. Squawk –

1. Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing.

2. Pilot – Normal UHF pilot squawk (Code 1,2, or 3 with a subsystem).

3. Passive Ground – Verification of collected fault data transmitted via RF link at EOR.

4. Active Ground – Human activated squawk transmitting fault codes via RF link

while on the ground. (Used for Ground Abort, Redballs).

5. Debrief – Detailed fault data and write-ups from debrief processing.

e. Time of squawk – Time the squawk occurred.

f. Code – MESL Code pertaining to this fault code.

g. Fault Code – Alphanumeric code indicating the failure.

h. Fault Description – Word description of the fault.

i. Repeats –Yes, if fault occurred in last flight. No, otherwise.

j. Recur - Yes, if same fault occurred within last five flights. No, otherwise.

k. Expenditures *(Read Only)*:

1. Squawk –

(a) Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing.

(b) Passive Ground – Verification of collected fault data transmitted via RF link at EOR.

l. Fuel – Percentage of fuel remaining.

m. Bombs– Number of bombs expended based on configuration of aircraft (e.g. 1 of 2).

n. Bullets– Number of bullets expended.

o. Missiles – Number of missiles expended based on configuration of aircraft (e.g. 2 of 2 AIM-120).

p. Flares - Number of flares expended.

q. Chaff - Number of chaff expended.

r. Copy Fault to Remarks – Allows the Pro Super to highlight a fault in the fault list and select this button to copy the current time, the fault code or pilot squawk type and fault description to the remarks area of the electronic status sheet. Refer to figure 16 for an example of the remarks copied for tail number 1394 for the fault identified by Pilot Squawk-3.

The PASS button provides the Pro Super with visual indications of up-to-date aircraft status. See Figure 22 – PASS Button Areas and Table 4 – Explanation of PASS Button Areas for detailed information.

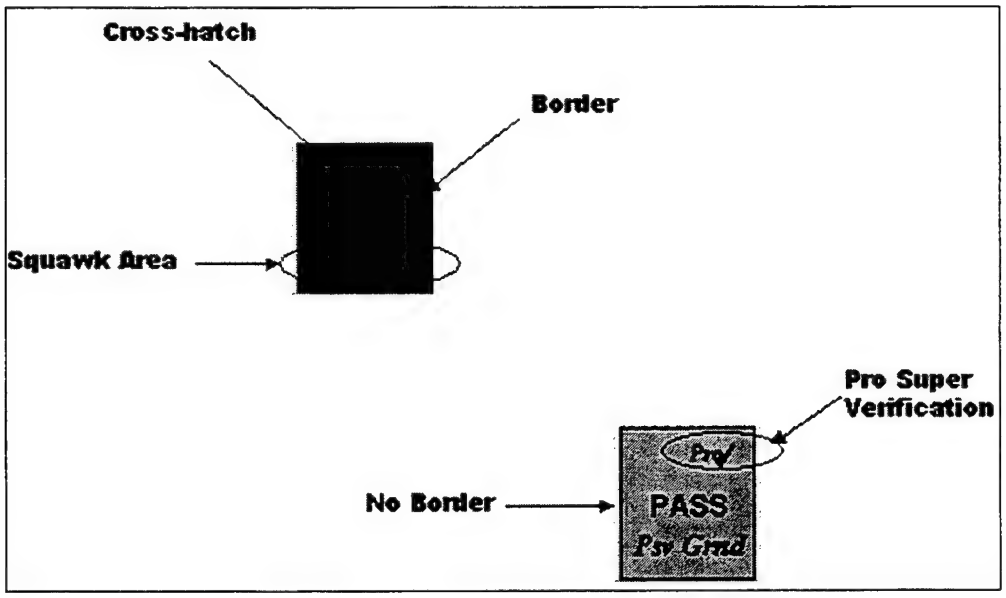

Figure 22 – PASS Button Areas

Table 4 – Explanation of PASS Button Areas

PASS Button Area	Description
Border	A border is placed on the PASS button if new PASS information has been received since the last time the user has viewed the detailed PASS data. The border is removed from the PASS button, when the user selects the PASS button to view the detailed PASS data.
Color	The background color of the PASS button indicates the suggested code or Pro Super identified code of the aircraft. Possible colors are: Green: Code 1 Yellow: Code 2 Red: Code 3
Cross-hatch	A cross-hatch is placed on the PASS button when new squawk data has been received from the aircraft. It indicates that the color of the PASS button reflects the suggested color based on the squawk information received and that the Pro Super has not yet verified the code of the aircraft. The cross-hatch is removed and replaced with the Pro Super Verification indicator when the Pro Super selects a code from the PASS Data Screen.

Squawk Area	The squawk area indicates the latest squawk type received from the aircraft. Possible squawk types are: Initial - For demonstration use only, indicates the initial condition of the aircraft at the start of a scenario. Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing. Pilot – Normal UHF pilot squawk (Code 1,2, or 3 with a subsystem). Passive Ground – Verification of collected fault data transmitted via RF link at EOR. Active Ground – Human activated squawk transmitting fault codes via RF link while on the ground. (Used for Ground Abort, Redballs). Debrief – Detailed fault data and write-ups from debrief processing.
Pro Super Verification	Indicates the Pro Super has looked at the detailed PASS information and has selected the appropriate code based on his knowledge of the aircraft, flying schedule and experience. The Status area (see Figure 7, is updated to the selected code based on the Pro Supers decision. Valid statuses are: FM: Fully mission capable or Code 1 PM: Partially Mission capable or Code 2 NM: Not mission capable/Hard broke or Code 3 Note: The Pro Super verification is removed and replaced with the cross-hatch upon another squawk coming in. The PASS button color is updated to the suggested status, however the Status area (see Figure 17, remains unchanged until the Pro Super makes a code decision).

4.3.3 APG Expediter Screens and Privileges

If the user logs in as an APG Expediter, a screen similar to Figure 23 – APG Expediter PASS Concept Screen is displayed. (Note: The only difference in the APG Expediters screen and the Pro Supers status screen is that the APG Expediter will only display the tail numbers he is assigned to. Also certain fields are unavailable to the APG Expediter for editing [see Figure 24 – APG Expediter Individual Tail Number for details]). By selecting the orange help key located near the top of the display, a help file is opened in a browser window with the same type of information provided in this section.

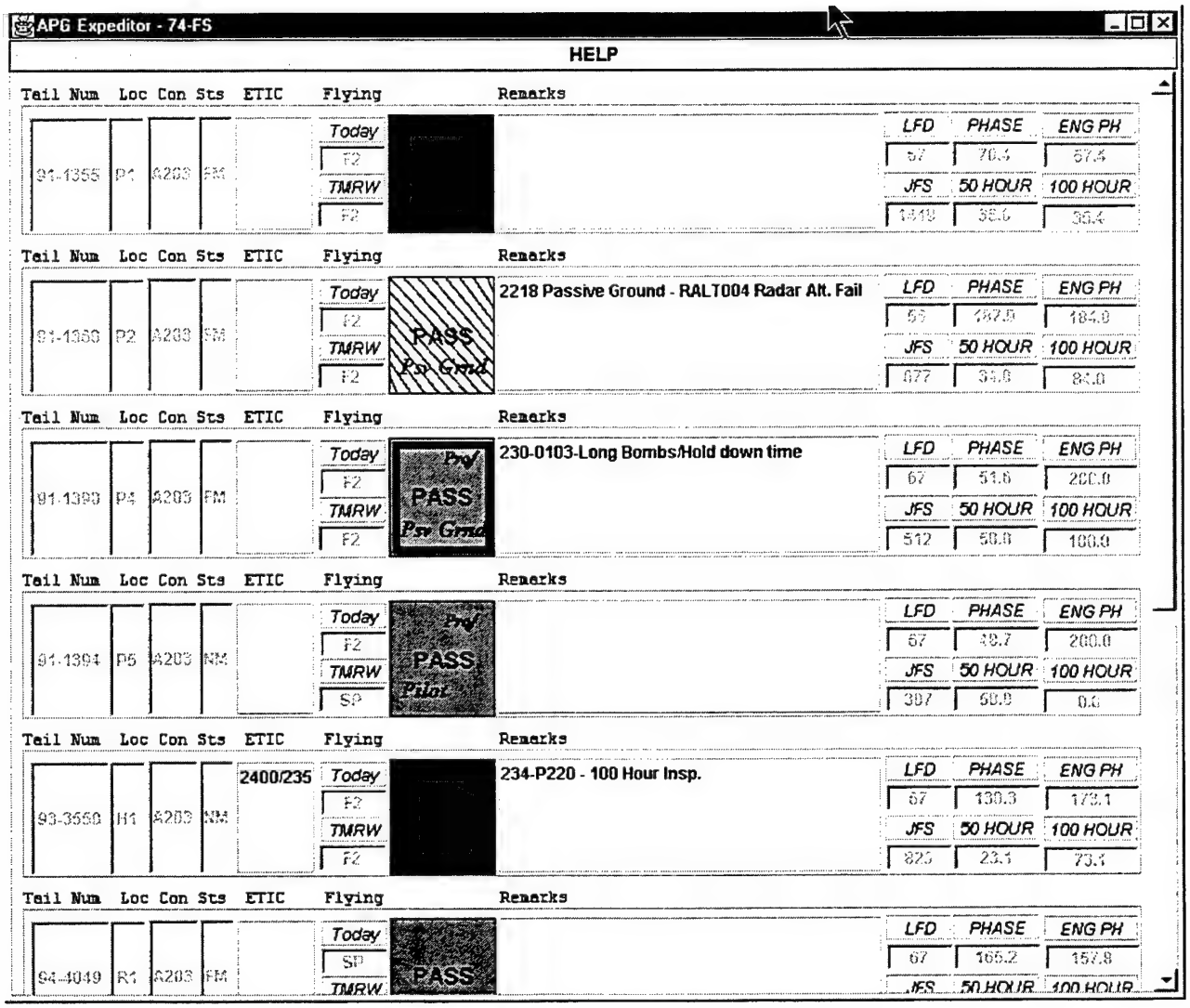

Figure 23 – APG Expediter PASS Concept Screen

The screen is an electronic version of the current clipboard status sheet used in today's maintenance environment. A row for each tail number assigned to the APG Expediter is displayed along with any pre-set scenario data for each aircraft. A single tail number and the data it displays are shown in Figure 24 – APG Expediter Individual Tail Number.

Figure 24 – APG Expediter Individual Tail Number

The tail number data represents the IMIS environment, which would become an

integral part of PASS (see Table 5 – Explanation of APG Expediter Individual Tail Number).

Table 5 – Explanation of APG Expediter Individual Tail Number

Area	Description
Tail Number	Indicates the tail number this row contains data for (Read Only).
*Loc	Location of the aircraft / Parking spot (Read Only).
*Con	Indicates the type of configuration the aircraft is in. (Read Only).
*Status	Indicates the status of the aircraft. FM: Fully mission capable or Code 1. PM: Partially Mission capable or Code 2. NM: Not mission capable/Hard broke or Code 3.
ETIC	Estimated Time In Completion – Available for the APG Expediter to make notes for himself on the completion time for the aircrafts maintenance. (Note: This area pertains only to this APG Expediter, these changes are not sent to any other user).
*Flying Today	How many times the aircraft is scheduled for flight today (e.g. F2 equals two flights for this aircraft today) (Read Only).
*Flying TMRW	How many times the aircraft is scheduled for flight tomorrow (e.g. F2 equals two flights for this aircraft tomorrow) (Read Only).
*PASS Button	Indicates the code of the aircraft based on the visual indicators, see Figure 22 – PASS Button Areas.
Remarks	Area available for the APG Expediter to write notes or issues pertaining to this aircraft. (Note: This area pertains only to this APG Expediter, these changes are not sent to any other user).
*LFD, *PHASE, *ENG *PHASE, *JFS, *50 Hour, *100 Hour	Common aircraft maintenance information to indicate how close to certain major maintenance milestones the aircraft is (Read Only).

* Any changes made to these fields by the Pro Super are sent to the APG Expediters and Specialist screens in real-time.

The button labeled PASS has been added to the electronic APG Expediter status sheet. The APG Expediter may select the PASS button to display the PASS DATA window. The PASS DATA window displays data for the indicated tail number, see Figure 25 – APG Expediter PASS Data Screen.

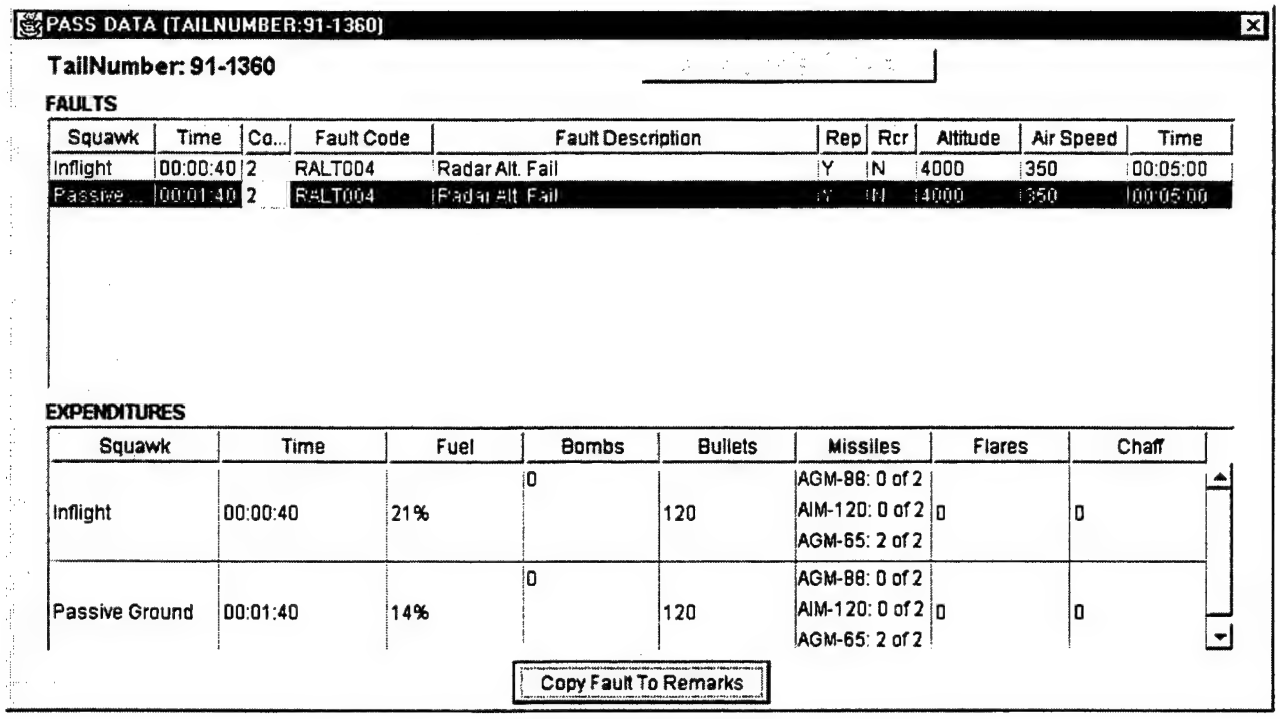

Figure 25 – APG Expediter PASS Data Screen

The PASS data available to the APG Expediter and the privileges, defined in italics:

a. TailNumber – identifies the tail number the data is detailed for *(Read Only).*

b. Code 1, 2, and 3 buttons – The current status of the aircraft as determined by the ProSuper *(Read Only).*

c. Faults *(Read Only):* The faults indicate the PASS or Pilot data transmitted.

d. Squawk –

1. Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing.
2. Pilot – Normal UHF pilot squawk (Code 1,2, or 3 with a subsystem).
3. Passive Ground – Verification of collected fault data transmitted via RF link at EOR.
4. Active Ground – Human activated squawk transmitting fault codes via RF link while on the ground (used for Ground Abort, Redballs).
5. Debrief – Detailed fault data and write-ups from debrief processing.

e. Time of squawk – Time the squawk occurred.

f. Code – MESL Code pertaining to this fault code.

g. Fault Code – Alphanumeric code indicating the failure.

h. Fault Description – Word description of the fault.

i. Repeats –Yes, if fault occurred in last flight. No, otherwise.

j. Recur - Yes, if same fault occurred within last five flights. No, otherwise.

k. Air Speed – Speed of aircraft when fault occurred.

l. Altitude – Altitude of aircraft when fault occurred.

m. Time – Time when fault occurred.

n. Expenditures *(Read Only)*:

o. Squawk –

1. Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing.

2. Passive Ground – Verification of collected fault data transmitted via RF link at EOR.

p. Fuel – Percentage of fuel remaining are displayed in percentage remaining.

q. Bombs– Number of bombs expended based on configuration of aircraft (e.g. 1 of 2).

r. Bullets– Number of bullets expended.

s. Missiles – Number of missiles expended based on configuration of aircraft (e.g. 2 of 2 AIM-120).

t. Flares - Number of flares expended.

u. Chaff - Number of chaff expended.

v. Copy Fault to Remarks – Allows the APG Expediter to highlight a fault in the fault list and select this button to copy the current time, the fault code or Pilot squawk type and fault description to the remarks area of the electronic status sheet. Refer to figure 20 for an example of the remarks copied for tail number 1360 for the fault identified by Radar Alt. Failure.

The PASS button has visual indications to the APG Expediter to minimize the time the APG Expediter has to go to the PASS menu while indicating the status of the current aircraft. Refer to Figure 22 – PASS Button Areas and Table 4 – Explanation of PASS

Button Areas for these visual indications.

4.3.4 Specialist Screens and Privileges

If the user logs in as a Specialist Expediter, a screen similar to Figure 26 – Specialist PASS Concept Screen is displayed. By selecting the orange help key located near the top of the display, a help file is opened in a browser window with the same type of information provided in this section.

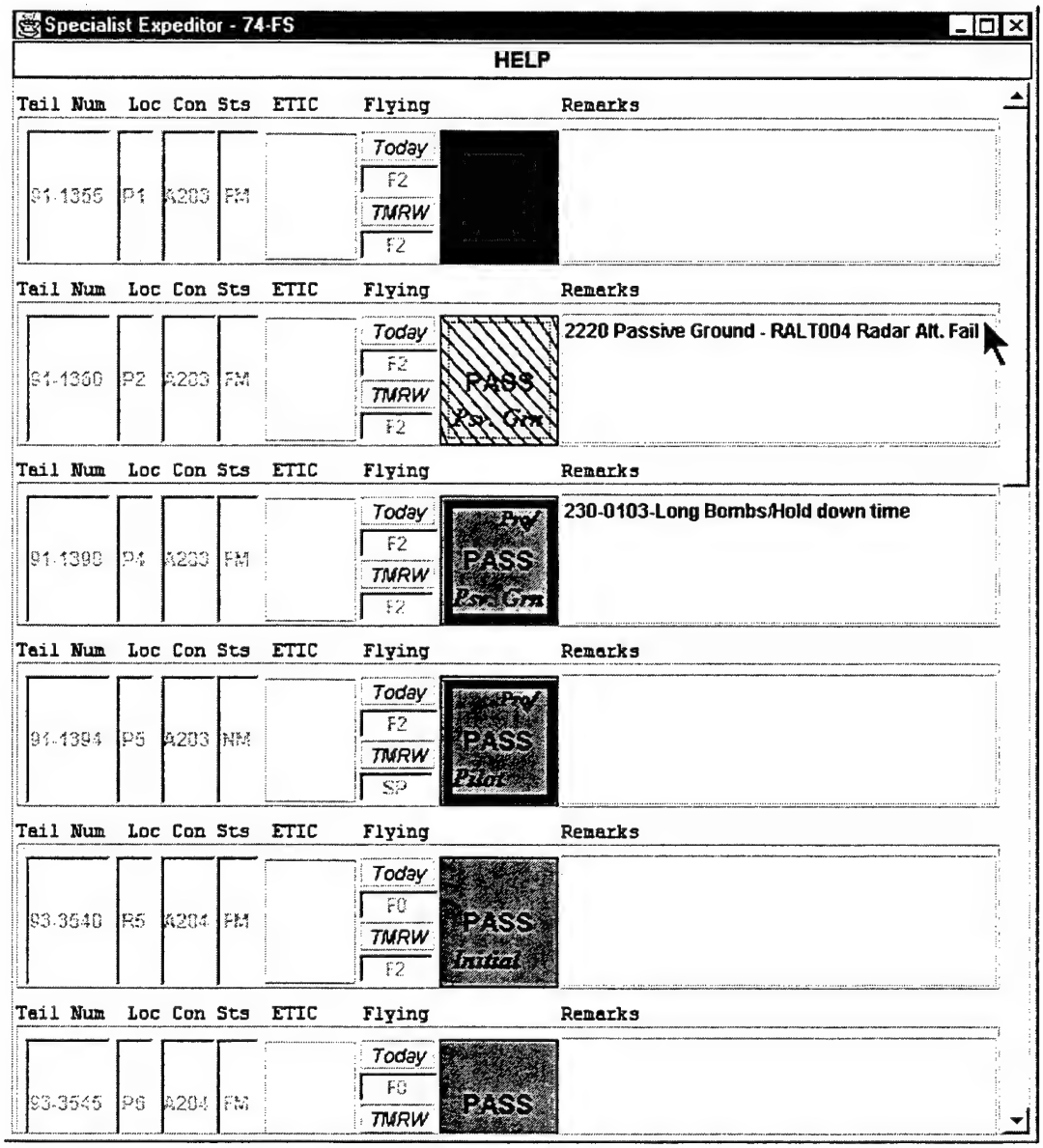

Figure 26 – Specialist PASS Concept Screen

The screen is an electronic version of the current clipboard status sheet used in today's maintenance environment. A row for each tail number assigned to the Specialist Expediter is displayed along with any pre-set scenario data for each aircraft. A single tail

number and the data it displays are shown in Figure 27 – Specialist Individual Tail Number.

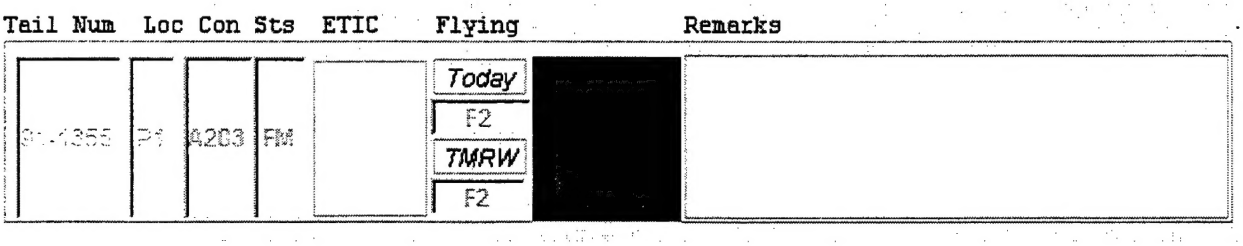

Figure 27 – Specialist Individual Tail Number

The tail number data represents the IMIS environment, which would become an integral part of PASS (see Table 6 – PASS Related Areas with Specialist Expediter Permissions).

Table 6 – PASS Related Areas with Specialist Expediter Permissions

Area	Description
Tail Number	Indicates the tail number this row contains data for (Read Only).
*Loc	Location of the aircraft / Parking spot (Read Only).
*Con	Indicates the type of configuration the aircraft is in. (Read Only).
*Status	Indicates the status of the aircraft. FM: Fully mission capable or Code 1. PM: Partially Mission capable or Code 2. NM: Not mission capable/Hard broke or Code 3.
ETIC	Estimated Time In Completion – Available for the Specialist Expediter to make notes for himself on the completion time for the aircrafts maintenance. (Note: This area pertains only to this Specialist, these changes are not sent to any other user).
*Flying Today	How many times the aircraft is scheduled for flight today (e.g. F2 equals two flights for this aircraft today) (Read Only).
*Flying TMRW	How many times the aircraft is scheduled for flight tomorrow (e.g. F2 equals two flights for this aircraft tomorrow) (Read Only).
*PASS Button	Indicates the code of the aircraft based on the visual indicators, see Figure 22 – PASS Button Areas.
Remarks	Area available for the Specialist to write notes or issues down pertaining to this aircraft. (Note: This area pertains only to this Specialist Expediter, these changes are not sent to any other user).

* Any changes made to these fields by the Pro Super are sent to the APG and Specialist Expediters in real-time.

The button labeled PASS has been added to the electronic Specialist Expediter status sheet. The Specialist Expediter may select the PASS button to display the PASS DATA window. The PASS DATA window displays data for the indicated tail number, see Figure

28 – Specialist PASS Data Screen.

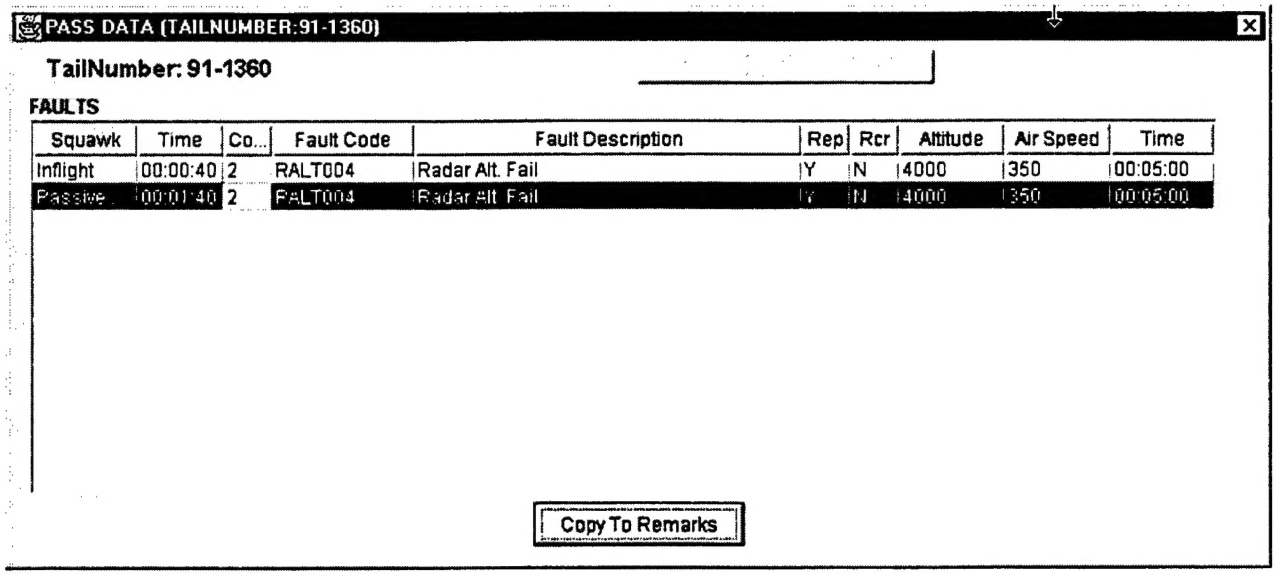

Figure 28 – Specialist PASS Data Screen

The PASS data available to the APG Expediter and the privileges, defined in italics:

a. TailNumber – identifies the tail number the data is detailed for *(Read Only).*

b. Code 1, 2, and 3 buttons – The current status of the aircraft as determined by the ProSuper *(Read Only).*

c. Faults *(Read Only):* The faults indicate the PASS or Pilot data transmitted.

1. Squawk –

(a) Inflight –Fault codes collected on the aircraft and transmitted via RF link before landing.

(b) Pilot – Normal UHF pilot squawk (Code 1,2, or 3 with a subsystem).

(c) Passive Ground – Verification of collected fault data transmitted via RF link at EOR.

(d) Active Ground – Human activated squawk transmitting fault codes via RF link while on the ground. (Used for Ground Abort, Redballs).

(e) Debrief – Detailed fault data and write-ups from debrief processing.

d. Time of squawk – Time the squawk occurred.

e. Code – MESL Code pertaining to this fault code.

f. Fault Code – Alphanumeric code indicating the failure.

g. Fault Description – Word description of the fault.

h. Repeats –Yes, if fault occurred in last flight. No, otherwise.

i. Recur - Yes, if same fault occurred within last five flights. No, otherwise.

j. Air Speed – Speed of aircraft when fault occurred.

k. Altitude – Altitude of aircraft when fault occurred.

l. Time – Time when fault occurred.

m. Copy Fault to Remarks – Allows the Specialist Expediter to highlight a fault in the fault list and select this button to copy the current time, the fault code or Pilot squawk type and fault description to the remarks area of the electronic status sheet. Refer to figure 23 for an example of the remarks copied for tail number 1360 for the fault identified by Radar Alt. Failure.

The PASS button has visual indications to the Specialist Expediter to minimize the time the Specialist Expediter has to go to the PASS menu while indicating the status of the current aircraft. Refer to Figure 22 – PASS Button Areas and Table 4 – Explanation of PASS Button Areas for these visual indications.

5. SUMMARY OF PASS EFFORT

The entire PASS effort in the past year resulted in proving that the PASS concept is a technically feasible and desirable concept that could be a performance enhancer and force multiplier for flightline maintenance personnel. There were technical reports generated for each phase of the effort, as detailed below:

a. Phase One – Technology Review and Data Collection shows that there are many technologies that make an air-to-ground data link for passing the PASS data very feasible.

b. Phase Two – Design and Analysis describes the PASS concept along with an encapsulation of high-level requirements from the field demonstrating the desires and benefits PASS has for the maintenance personnel. It also provides several measurable business cases to show PASS is a value-added concept.

c. Phase Three – Preliminary Plan for Technology Development and the actual PASS demonstration software, documents and describes the PASS Demonstration concept in an electronic maintenance environment which could be applied to today's aircraft or future aircraft.

This PASS effort has laid a solid foundation for further development and implementation of the concept.

6. REFERENCES

- Passive Aircraft Status System (PASS) Technology Review and Data Collection, Report #AFRL-HE-WP-TR-2000-0143, AD-B264777.

- Passive Aircraft Status System (PASS) Design and Analysis (Report to be published at a later date).

- Passive Aircraft Status System (PASS) Preliminary Plan for Technology Development (Report to be published at a later date).